

Do Elephants (*Elephas maximus*) debark specific tree species? Western Ghats, South India

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ABSTRACT

Elephant contribute significantly to the composition and dynamics of the forest vegetation through trampling, browsing and debarking. Detailed information about debarking of trees species by elephant is scarce in certain part of their distributional range. Such debarking behaviour information is important to understand a species behavioural adaptation and potential threat to the food plants. Therefore, we studied debarking behaviour of Asian elephants in Bilgiri Rangaswamy Temple Tiger Reserve, India. We recorded debarking of tree species by elephant via indirect observation (sign of debarking) along (n=3) transect in three vegetation types (dry, moist and scrub forest) during the summer month, 2012. The greatest number of tree species were debarked from dry deciduous forest (22) followed by moist deciduous (18) and scrub forests (12). Food plant preferences are discussed.

Keywords: BRT, debarked, elephants, vegetation type

1. INTRODUCTION

The dynamic of forest vegetation is significantly influenced by large mammals like elephants (*Elephas maximus*) and Gaurs (*Bos gaurus*) (Sukumar, 1989). They also have an impact on the forest through debarking and trampling (Hoft and Hoft, 1970; Sheil, 1996; Strushaker et al., 1996; Wing and Bush, 1970). During the dry season when there are no leaves, it consumes barks that severely harm the trees. Asian elephants have the same potential to kill trees as African elephants (Ishwaran, 1983; Sukumar, 1989; Pradhan et al., 2007). It may preferentially eat fruits or pods and remove bark from tree (typically) the cambium (Sukumar, 1989; Campos-Arceiz et al., 2008a, 2008b). Several studies have been conducted on feeding ecology of elephants in Western Ghats, Northeast and North West India. However, those studies have focused on preliminary observation in the BRT Tiger reserve. In the present study we focused on debarking and non - debarking behaviour of elephants in three different forest types (dry, moist and scrub forests) in the BRT Tiger Reserve, Karnataka, India. A total of 713 elephants 610 in BRT Tiger reserve (Kumara et al., 2012).

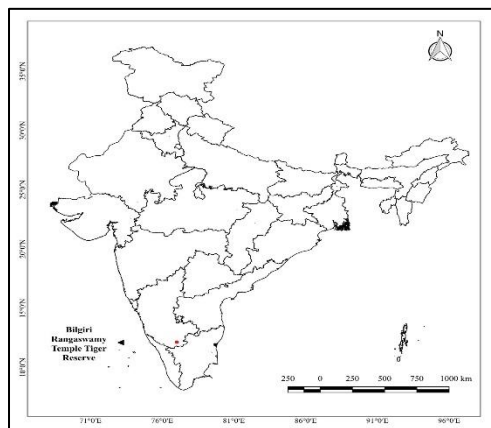


Figure 1 Map shows location of Bilgiri Rangaswamy Temple Tiger Reserve in Southern India.

Study Site

The BRT Tiger reserve covers an area of about 540 km² in area, is located between 11°40' and 77°15' E of Western Ghats in Karnataka, Western Ghats, India (Figure 1). The elevation varies from 1400-1800m and the average rain fall is about 1500mm. The minimum and maximum temperatures range from 8°C to 16°C and 20°C to 38°C degrees Celsius, respectively, depending on the location and time of day the main forest types are Scrub jungle (28.2%), dry deciduous 36.1%, evergreen 10.3%) and shola forests and high-altitude grasslands within the reserve (Ramesh, 1989). The diverse array of climates also contributes to the heterogeneous assemblage of habitats, including scrub, deciduous, riparian and evergreen. The most common type of forests is deciduous and scrub jungles. Species like *Pterocarpus marsupium*, *Anogeisus latifolia* and *Dalbergia latifolia* are found in dry deciduous forests because they are open and have these characteristics. At higher altitudes the under storey of the dry deciduous trees are with grasses such as *Themidacymbaria*, *Themidatriandra*, *Cymbopogon* sp. and various *Papilionaceae* shrub species. Scrub forest occurs along the pheryphery of the BRT and is dominated by *Acacia sundra*, *Albizia amara*, *Anogeisus latifolia* and *Euphorbia antiquarum*. Evergreen forest found in higher elevation and along streams. BRT also rich in herbivores like Elephant, Gaur, Sambar, Barking Deer and Chetal about 1200 elephants live in BRT Tiger Reserve and adjoining forests (Sukumar, 1989). Within the sanctuary, a large number of human settlements can be found, including those of indigenous, temple employees and private plantation estates that cultivate cardamom (*Elettaria cardamomum*), coffee (*Coffea arabica*), pepper (*Piper nigrum*), etc.

2. METHODS

Vegetation was sampled in five 600X20m transects laid in each vegetation types dry, moist and scrub forests. Indirect observation on signs of debarked trees (>30cm GBH) were enumerated in the 50X10m segment at 50m intervals along the transects in each vegetation types (dry or moist and scrub) forests. Bark preference was estimated based on the relative frequency of each debarked trees using formula $B = (n_b/N) \times 100$ where, n_b = number of records of b and N =total number of debarked trees enumerated during the study period. One-way Anova were used to find out is there any significant different in debarked tree across the three vegetation types at BRT. The data were analysed using PAST statistics. The result on debarking trees was discussed on different vegetation type's basis to understand the variation in debarking behaviour pattern.

3. RESULTS AND DISCUSSION

In the observed area 28 plant species were debarked by elephants. The most commonly debarked trees species were from 19 families. In the study area in dry deciduous forest 22, moist deciduous forest 18 and scrub Jungle 12 species were debarked by elephants (Figure 2). The mean number of debarked trees in dry deciduous (e.g. 13.82 ±21.53 SD), moist deciduous (e.g. 8.61±10.53 SD) and scrub forests (e.g. 3.61±9.21 SD). The greatest Shannon diversity index for debarked trees in dry deciduous forests were (2.437) and lowest in scrub jungle (1.715) (Figure3). The maximum number of trees debarked from dry deciduous (387), Moist deciduous (155) and Scrub Jungle (104) (Figure 4).

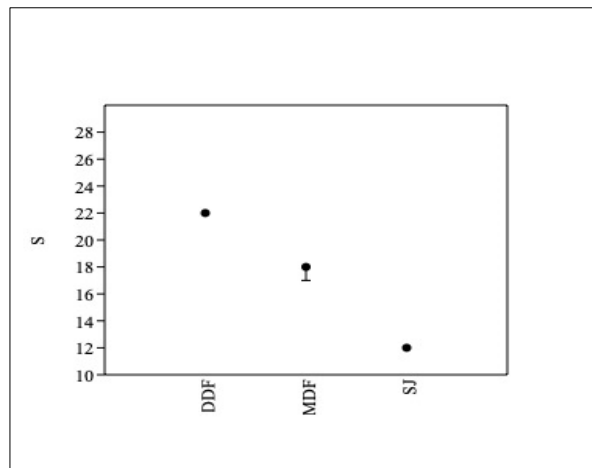


Figure 2 Species richness of debarked trees by elephants in three different vegetation types in BRT Tiger Reserve.

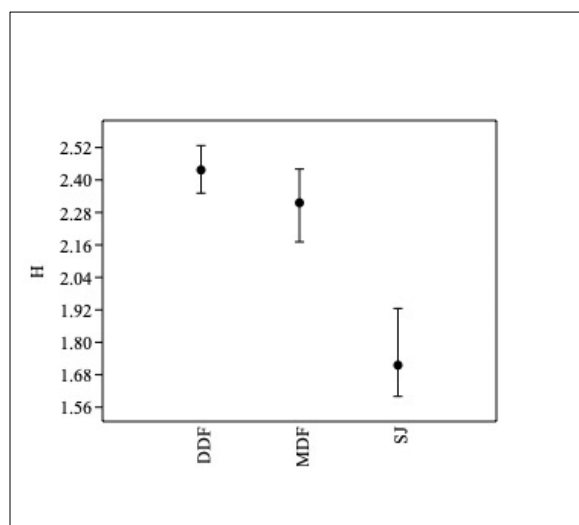


Figure 3 Shannon index for debarked trees by elephants in three different vegetation types in BRT Tiger Reserve.

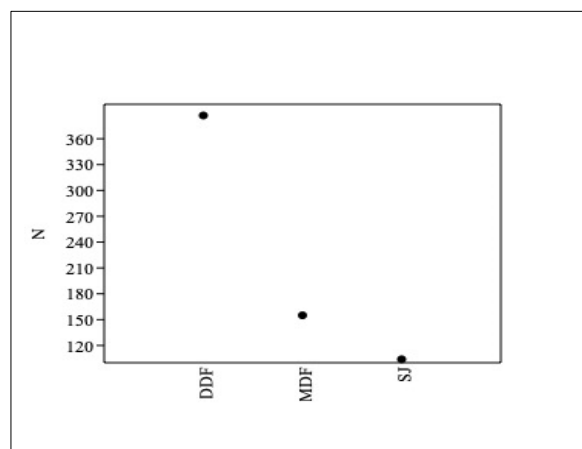


Figure 4 Number of individuals trees debarked by elephants in different vegetation types at BRT Tiger Reserve.

The mean number of non- debarked trees in dry deciduous (e.g. 16.34 ± 77.33 SD), moist deciduous (e.g. 4.20 ± 13.89 SD) and scrub forests (e.g. 11.58 ± 33.85 SD). The number of non-debarked trees species in the dry deciduous forest were (33), moist deciduous forest (29) and scrub jungle (25) respectively (Figure5). Shannon index for dry deciduous forest were (1.79), moist deciduous (2.262) and scrub forests (2.22; Figure 6). The density of non-debarked trees in dry deciduous forests (948), moist deciduous forest (244) and scrub jungle (672; Figure 7)

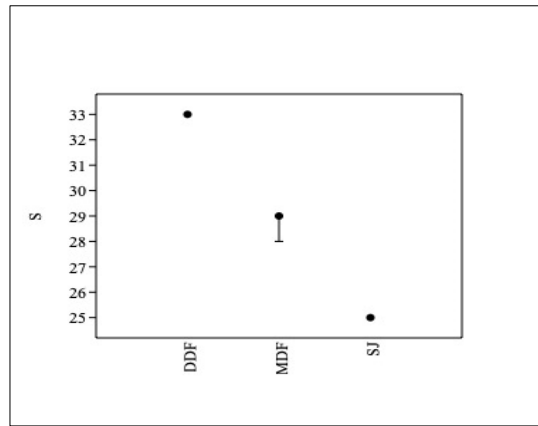


Figure 5 Species richness of non-debarked trees in three different vegetation types at BRT Tiger Reserve.

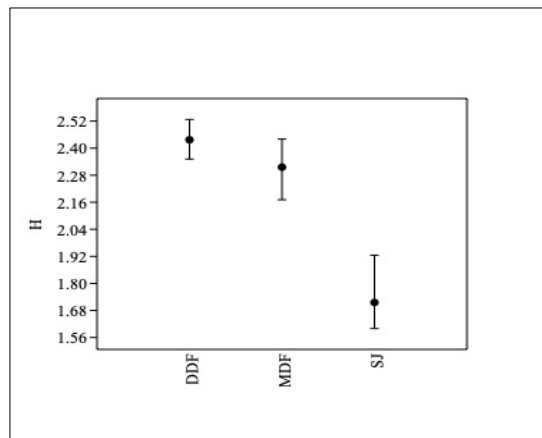


Figure 6 Shanon index for non-debarked trees in various vegetation types at BRT Tiger Reserve.

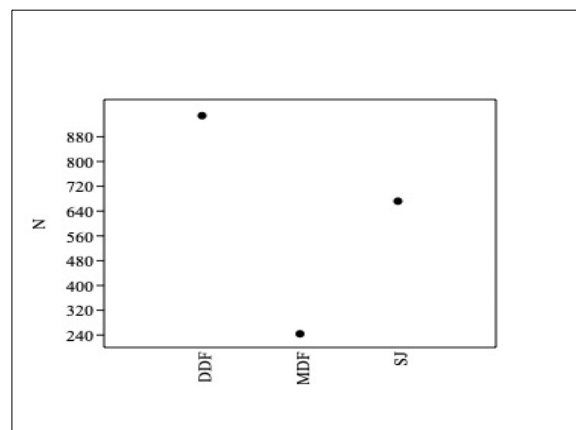


Figure 7 Number of Individual trees non debarked by elephant in different forests

There was a significant different in debarked tree species across dry, moist and scrub forests in BRT ($p=0.025$), (Table 1). The most commonly debarked tree species were *Tectona grandis*, *Grewia tiliaefolia*, *Saccopetalumtomentosum*, *Terminalia crenulata*, *Pterocarpus marsupium*, *T. paniculata*, *Eriolaenalushingtonii* and *Zizyphusxylopyrus*. In dry deciduous forests *Tectona grandis*, *Grewia tiliaefolia*, *Saccopetalumtomentosum*, *Terminalia crenulata* and *T. paniculata* were highly debarked. In moist deciduous forest *Terminalia crenulata*, *T.paniculata*, *Grewia tiliaefolia*, *Eriolaenalushingtonii*, *Pterocarpus marsupium* were debarked by elephants. In scrub jungle *Grewia tiliaefolia*, *Zizyphusxylopyrus*, *T.chebula* and *Tectona grandis* were highly debarked (Table 2).

Table 1 Anova for debarked tree species by elephant in three vegetation types in BRT

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1625.166667	2	812.583333	3.83187234	0.02569966	3.10931055
Within Groups	17176.78571	81	212.059083			
Total	18801.95238	83				

Table 2 List of debarked trees species observed in dry, moist and scrub forest at BRT.

Sl.No	Species name	Family name	Dry Deciduous forest (%)	Moist Deciduous forest (%)	Scrub Forest (%)
1	<i>Bauhinia variegata</i>	Caesalpineaceae	1.55	1.94	0.00
2	<i>Bombax ceiba</i>	Bombacaceae	0.26	0.00	0.00
3	<i>Bridelia retusa</i>	Phyllanthaceae	4.91	2.58	0.00
4	<i>Butea monosperma</i>	Fabaceae	0.78	0.65	0.96
5	<i>Cordia obliqua</i>	Boraginaceae	1.29	4.52	0.00
6	<i>Eriolaaenalushingtonii</i>	Malvaceae	2.07	10.97	0.00
7	<i>Ficus bengalensis</i>	Moraceae	0.26	0.00	0.00
8	<i>Givotiarottleriformis</i>	Euphorbiaceae	0.00	0.00	0.96
9	<i>Gmelina arborea</i>	Verbenaceae	0.26	1.29	0.00
10	<i>Grewia hirsuta</i>	Sterculiaceae	0.26	0.00	0.00
11	<i>Grewia tiliaefolia</i>	Sterculiaceae	14.99	14.84	33.65
12	<i>Ougeineaoojeinensis</i>	Leguminaceae	2.58	0.00	0.00
13	<i>Premna tomentosa</i>	Verbenaceae	1.29	0.00	2.88
14	<i>Pterocarpus marsupium</i>	Leguminaceae	8.53	8.39	1.92
15	<i>Saccopetalumtomentosum</i>	Annonaceae	11.37	0.00	4.81
16	<i>Schleicheraoleosa</i>	Sapindaceae	0.52	0.65	0.96
17	<i>Semecarpus anacardium</i>	Anacardiaceae	1.29	0.00	0.00
18	<i>Sideroxylontomentosum</i>	Sapotaceae	0.00	0.65	0.96
19	<i>Sterculia villosa</i>	Sterculiaceae	0.52	0.00	0.00
20	<i>Tectona grandis</i>	Verbenaceae	23.51	0.00	7.69
21	<i>Terminalia chebula</i>	Combretaceae	2.58	1.94	10.58
22	<i>Terminalia crenulata</i>	Combretaceae	9.04	24.52	0.00
23	<i>Terminalia paniculata</i>	Combretaceae	8.01	16.13	0.96
24	<i>Terminalia tomentosa</i>	Combretaceae	0.00	4.52	0.00
25	<i>Zizyphusxylopyrus</i>	Rhamnaceae	4.13	1.29	33.65
26	<i>Careya arborea</i>	Lecythidaceae	0.00	1.29	0.00
27	<i>Kydiacalycina</i>	Malvaceae	0.00	2.58	0.00
28	<i>Sterculia guttata</i>	Sterculiaceae	0.00	1.29	0.00

4. DISCUSSION

Elephants use the soft twigs of the trees by removing the leafy portion from it; bark from woody plant is often ripped off for feeding purpose. Since bark is rich in calcium, elephants would select this resource, which is sometimes essential for the favourable growth of skeleton and for the tusks in males (Joshi and Singh, 2008). A study was also conducted on the debarking behaviour of elephants

in southern India, which shows that maximum number of debarked trees were from dry deciduous forests (Vanaraj, 2001) and Satkosia Tiger Reserve in Odisha by (Pradhan et al., 2011).

Earlier researcher noted that elephants consume other tree species bark. Similar research was done on elephant debarking behavior in Southern India which shows that maximum number of debarked trees was from dry deciduous forests (Vanaraj, 2001) and Satkosia Tiger Reserve in Odisha by (Pradhan et al., 2015). Elephant consume the bark of variety of trees, including *Acacia suma*, *Grewia tiliaefolia*, *Kydiacalycina*, *Zizyphusxylopyrus*, *Tectona grandis* and *Eucalyptus* spp, similarly were also found by us in the scrub forest. It is clear that some species, regardless of the type of vegetation, could serve as elephants primary sources of nutrition. Elephants may use the bark of different tree species to balance their macronutrient intake (Laws et al., 1975) as well as to gain moisture and mineral supplements (Bax and Sheldric, 1963). The current study provides background knowledge on the various debarked trees species options available in BRT Tiger reserve as well as their nutritional value. Further studies are needed to understand this debarking behaviour and the relationship between tree damage and mortality rates. This knowledge is crucial for achieving the long-term conservation of Asian elephants and improved seasonal management. It would be helpful to conduct research on the chemical composition of bark merit investigation explain why elephants consume the bark of particular tree species and not other tree species.

5. CONCLUSION

Debarking can have a variety of outcomes. Low-level damage may not harm the tree, however high-level debarking can disrupt nutrient and water conductance, perhaps leading to the tree's death.

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Animal ethics

Data for this study had been collected based on indirect observation; therefore, clearance from Animal Ethical Committee is not required.

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Conflicts of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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